

Sequence diversity among haplogroup A mtDNA control region lineages in an Alaskan Na-Dene

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The majority of Native Americans mtDNAs belong to one of four haplogroups that are defined by RFLP analysis and sequencing of the first hypervariable region (HVI). The distribution of the four haplogroups (A-D) in the New World is not homogeneous with respect to either geography or linguistic affiliation. The patterning of mtDNA variation has been related to controversies about the peopling of the Americas and the correlation between genetic and linguistic relationships. Populations which comprise the Na-Dene linguistic phylum are important to understanding these issues since it has been proposed that they represent, either with Eskimo-Aleuts or separately, a later migration from that which established the Amerind phylum. This study analyzes mtDNA from an Alaskan Na-Dene speaking population, the Tanana.

Samples for DNA analysis were collected with informed consent from volunteers (N=40) in Fairbanks, Alaska. In addition, the ethnic affiliation of all four grandparents was recorded for each subject. Using RFLP analysis we established haplogroup affiliation for all individuals. Of these, we sequenced the HVI region for the individuals identified as belonging to haplogroup A (N=35). These sequences were compared with 870 published mtDNA sequences from East Asia (N=305), North American Amerinds (N=189), another Na-Dene population (Haida, N=41), Central American Amerinds (N=136) and South American Amerinds (N=199).

Analysis of the Tanana haplogroup A sequences showed that they belonged to 13 lineages, four of which had not been previously described. Constriction of a Fitch-Margoliash tree separates Asian from New World haplogroup A but does not partition the lineages by linguistic phyla, giving support to a single migration and subsequent divergence for all New World populations.

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What happened to sexual dimorphism in the modern adult chin base? S. R. LOTH, Anatomy (Medicine), University of Pretoria, 0001, South Africa, and M. HENNEBERG, Anatomical Sciences, University of Adelaide, S. Australia 5005

Like other traditional sex determination methods, descriptions of "chin" morphology have been handed down with no systematic quantification. In fact, growth research concluded that chin shape is hereditary rather than sex-linked in modern humans. Evolution of the hominid symphyseal region has been studied extensively, but not with a focus on sexual dimorphism, especially in premodern mandibles. Thus, the purpose of this paper is to investigate the evolutionary and developmental factors

that affect the form of the mandibular symphysis and the manifestation of sexual dimorphism. A multi-population sample of 610 known sex individuals from birth to over 90 years along with original hominid fossils and casts were studied. Sexing accuracy was quantified, as were population differences, and changes with age and over time. The mental protuberance was too variable to be of any use, so only the anterior base of the mandible was assessed. Each mandible was evaluated as having the traditional male (straight or undercut) or female (rounded or pointed) shape. Results indicated that adult shapes were in place by 6 years of age and sexing accuracy for ages 6-19 (68.6%) was not significantly different from that of adults 20 years and older (71.1%). Chi² tests did reveal significant population differences. In all recent U.S. whites, blacks, and African blacks, male shapes predicted males significantly better because female shapes were more often found in males. The reverse held true for the Paleoamericans. In all hominids prior to the appearance of menton, only two base shapes were noted - undercut in males; little or none in females and these were all consistent with earlier sex assessments. This, coupled with anatomic differences prior to the appearance of menton, suggests greater dimorphism in the anterior bellies of the digastric muscles in the past. In conclusion, the relatively low predictive value in modern samples and significant group differences support earlier findings that modern chin shape is not primarily sex-linked.

Changes in Cortical Area in the Individual Human Rib. K.R. LOTZ, Department of Anthropology, University of Missouri-Columbia, MO 65211

Despite ever-improving techniques in the recovery of archaeological human remains, skeletal populations that, due to poor preservation, are incomplete or fragmentary plague bio-archaeologists. Histological analysis is a tool which not only provides valuable bioarchaeological information, but can be applied to even very fragmentary remains. Most histomorphometric methods of analysis, however, require adequate microstructural preservation. If microstructural preservation is lacking though, there is still valuable information that can be obtained histologically. There is a wealth of clinical data on age-associated changes in cortical and total cross-sectional area for the rib. These measures, which are easily obtained and do not require preservation of internal microstructure, can provide valuable information regarding age-associated cortical bone loss and how it varies among populations differing in antiquity and modes of subsistence. Because of the issue of fragmentary remains, the question of intraskeletal variation in these measures of bone mass is important. Preliminary to the application of this method to archaeological samples where the precise skeletal location at which these measurements can be made may not be known, the range of intra-rib variation in total and cortical areas and the ratio of these areas is estimated. The sixth rib from two modern skeletons housed at the Human Skeletal Identification Laboratory at the

University of Missouri Anthropology Department was obtained for analysis. Each rib was sectioned at 3 cm intervals using a Buehler Isomet thin sectioning saw to produce a total of 19, approximately 1000 microns thick sequential transverse cross sections along their lengths. The sections were digitally scanned, and cortical and total cross-sectional areas were determined using Scion Image. Results show that, although a large range exists from the vertebral to the sternal end of the rib, this range is greatly reduced when the vertebral section and the last two sternal sections of the rib are removed from consideration. It is concluded that any measures of cortical and total cross-sectional area, exclusive of these sections, can be compared among individuals.

The Evolution of Hominoid Hands: Growth scaling registers with posterior HOXD expression. C.O. LOVEJOY¹, P.L. RENO¹, M.A. McCOLLUM^{1,2}, M.W. HAMRICK¹ and M.J. COHN³. 1) Division of Biomedical Sciences, Kent State University, Kent OH 44242; 2) Department of Anatomy, Case Western Reserve University, Cleveland OH 44106; 3) Division of Zoology, School of Animal and Microbial Sciences, University of Reading, Whiteknights, Reading RG6 6AJ UK

The hands of great apes and humans are very similar morphologically but differ systematically in digital proportions. This implies a potentially modular basis of size. Since *Abdominal-B*-related *Hox* genes have been shown to act as growth regulators in the autopod, we explored the size relationships among elements which share their expression. Our measurements, taken from a balanced sample composed of all five hominoid genera (N = 65), include the lengths of the proximal and distal radius (defined by the nutrient foramen), all 5 metacarpals, and the proximal 2 phalanges of each ray. All were size normalized using geometric means of joint dimensions. In addition, we monitored the expression of posterior HOXD genes in developing murine autopods using whole-mount *in situ* hybridization of riboprobes.

Analysis of covariance demonstrates a strong functional relationship between the four posterior rays and the distal radius, but no relationship with the proximal radius. *In situ* hybridization demonstrates that the growth plates of the distal radius and posterior four digits collocate with *Hoxd11* expression. These data, combined with those from gain and loss of function experiments, suggest that hominoid digit and distal forearm proportions are determined by differences in the proportional expression of posterior HOXD genes, probably involving positional changes in *cis* acting control elements. Similar, relatively simple, changes in gene expression can wholly explicate the probable pattern of evolution in the early hominid hand and forearm skeleton, including the emergence of unusually short posterior digits and forearms in the time period between *Australopithecus garhi* and *Homo habilis/erectus*. Such changes are likely to be related to developments in lithic technology and to be completely unrelated to locomotion.

Mummy dearest: the identification and analysis of Jordan's first mummy. M.L. LUCAS, Dept. Of Anthropology, University of Arkansas, Fayetteville, A.C. AUFDERHEIDE, School of Medicine, University of Minnesota, Duluth, and M. EL-NAJJAR, Institute of Archaeology and Anthropology, Yarmouk University, Irbid, Jordan.

In August 1996, the Jordanian Department of Antiquities confiscated a mummy from an antiquities smuggler. The mummy was seized by an undercover agent during a transaction with the dealer, who, falsely claiming the mummy was 4000 years old, was trying to sell him for a princely sum. Being the first mummy ever found in the Hashemite Kingdom of Jordan, the discovery created quite a stir, even inspiring visits from royalty to the jail cell location where the mummy was being housed. Faculty members from the Institute of Archaeology and Anthropology at Yarmouk University were called upon to verify the authenticity of the mummy.

This project centers on the analysis and identification of this find, Jordan's first mummy. The examination combines the techniques of a standard osteological study, radiological analysis, radiocarbon dating, stable carbon isotope analysis, and a histological analysis of the hard tissue.

The results reveal the age at death, date of death, pathologies, diet, and habits of this young man.

Plant mechanics and primate dental adaptations: an overview. P.W. LUCAS, Anatomy, University of Hong Kong.

For primate dentitions to adapt to plant physical properties, animals must have either specialised diets or else select food on mechanical grounds. There are two relevant mechanical defenses: toughness and hardness. Toughness is optimized in composites (organized mixtures) like plant cell wall (fiber), in which cellulose fibrils are set in a lignin/hemicellulose 'glue'. Is fiber toughness the major obstacle for breakdown by teeth? A study of 77 plant tissues/plant-based materials of known fiber content (defined as the cell volume fraction that is fiber, V_c) identified two causes of toughness. Fiber toughness is $\approx 3.4 \text{ kJ m}^{-2}$, in proportion to V_c . This cost is dwarfed though by cell walls buckling plastically into the intracellular lumen (only 'woody' cells do this, depending on fibril alignment). Maximally, in woody cells of $V_c = 0.7-0.8$, this absorbs 40 kJ m^{-2} (10 times that of the cell wall), but tends to zero as $V_c \rightarrow 1.0$. A central tenet of feeding selection is that primates avoid fiber. Toughness (often measured wrongly) is sometimes treated as the physical equivalent of fiber. This study shows that this is false: a cellular mechanism produces high toughness. Feeding decisions may be based on toughness not fiber. Feeding

on foods of limited toughness range would explain why postcanines of folivorous primates have blades. These control cracks, which can then cross buckling cell walls of some leaf tissues, fragmenting them. Hardness (H) in plant cells involves cell walls of $V_c > 0.9$. However, this closes cell lumina, eliminating plastic buckling, and so decimating toughness. Most 'hard' structures are isotropic (directionally uniform) fruit/seed coverings with interweaving woody cells. Molars of primates opening such foods are blunt-cusped: for high initial forces, cracks grow at low cost ($< 1 \text{ kJ m}^{-2}$) between cells. These coverings fragment because cells are interwoven, not aligned. Thick-walled seed shells have $H < 300 \text{ MPa}$. In primate enamels, $H > 2500 \text{ MPa}$, matched only by single-component (non-composite) construction associated with opaline silica ($H \approx 6000 \text{ MPa}$). Supported by the RGC of Hong Kong.

Mapping chromosome 18 in the rhesus macaque (*Macaca mulatta*). L.R. LUDVICO, S.L. CLIFFORD, K. MOSMAN, K. MASSEY, Q. TRAN, K.E. CHAMBERS, S. SLIFER, S. OSTROWER, Q. NGO, M. KEELING, W.H. STONE. Dept. of Biology, Trinity University, San Antonio, Texas, 78212.

Comparative genome mapping is an extremely valuable tool both in the study of inter-species evolution and, in the case of primates, in biomedical research. Rhesus macaques, in particular, have been used towards this end, making a genetic linkage map of this species especially beneficial. Here, we report on the amplification of human microsatellite homologs in rhesus macaques.

Comparative linkage maps of the human and baboon 18th chromosome show conservation of marker order between species. We have genotyped these same markers in 335 rhesus macaques from the University of Texas, M.D. Anderson Cancer Research Center, Bastrop, Texas. These rhesus macaques consist of 14 multigenerational, pedigreed families. The rhesus macaque linkage map that will be developed from these data, therefore, will be directly comparable to the human and baboon linkage maps.

Preliminary analysis shows that markers D18S849 and D18S38 are linked in the rhesus macaque as they are in the human and baboon linkage maps. We anticipate that marker order will be conserved among the three species as the remainder of the markers is added to the linkage map.

Social Proximity to a Postpartum Chimpanzee and Her Infant in a Captive Group. ¹LUECKE, L.G., ²LAMBETH, S.P., ²SCHAPIRO, S.J. ¹Department of Anthropology, Southwest Texas State University, San Marcos, TX 78666. ²University of Texas, M D Anderson Cancer Center, Bastrop, TX 78602.

In the wild, research done on chimpanzees shows that infant rearing involves little social interaction with individuals outside the mother-infant dyad, and that the mother maintains no permanent associations with other members of the community besides her own offspring. Although the patterns of infant development in captivity are thought to be similar to patterns in the wild, a difference in the levels of specific behaviors might be expected due to social factors and ecological pressures of captive existence. Nevertheless, the apriori hypothesis of this study predicts that consanguinal relatives will have more proximity access than other animals, regardless of their dominance rank.

The study sample was a group of captive chimpanzees at the M D Anderson Cancer Research Center Science Park in Bastrop, Texas. The group consisted of twelve individuals of differing ages and sex, housed in an indoor/outdoor compound. Data were collected three times a week and began five days after the birth of the infant. Each test period was thirty minutes in duration and consisted of observation scans at thirty second intervals. A total of 22.5 hours of data were collected using the one/zero sampling technique. A probability level of .05 was considered significant.

Compared to non-related animals, related animals had a higher mean occurrence of social behaviors with the mother (proximity, groom, receive groom, and follow behaviors). The mother had the highest rates of non-infant interaction with her mother and her sister, although they were middle and low ranking, respectively. Interactions were lowest with a second matrilineal line housed in the same group.

This study supports the notion that the affiliative bond between matrilineal relatives exists and endures through grooming and social support. The strength and persistence of consanguinal relationships found in the wild do appear to exist in captive groups.

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Enamel Hypoplasia in Deciduous Teeth of Great Apes: Variation in Prevalence and Timing of Defects. J.R. LUKACS, Dept of Anthropology, University of Oregon, Eugene, OR 97403-1218

The prevalence of enamel hypoplasia in the deciduous teeth of great apes has the potential to reveal episodes of physiological stress in early stages of development. Little is known about defects of deciduous teeth in great apes: Are hypoplastic defects equally common in different groups of great apes? Are enamel hypoplasias more common in the deciduous teeth of male or female apes? When during dental development do enamel defects tend to form? What part of the dental crown is most commonly affected?

To answer these questions, infant and juvenile skulls of three genera of great apes were examined for dental enamel

hypoplasias. Specimens from the Cleveland Museum of Natural History (Hamman-Todd Collection; n=100), Powell-Cotton Museum (Quex Park, UK; n=107), and Smithsonian Institution (National Museum of Natural History; n=36) were studied by the author. All deciduous teeth were examined with a 10X hand lens in oblique incandescent light; defects were classified using FDI/DDE standards.

Enamel defects of ape deciduous teeth are most common on the labial surface of canine teeth. While deciduous incisor and molar teeth consistently exhibit prevalences of ~10%, canines average between 70%-75%. Among the great apes, gorillas (87-92%), and orangutans (91%) have a significantly higher prevalence of canine enamel defects than chimpanzees (22-48%). Sex differences in canine enamel hypoplasia were small and not statistically significant in any ape. Position of enamel defects on the canine crown was analyzed by dividing it into three zones (apical, middle, cervical), and calculating defect prevalence by zone. Among gorillas, enamel hypoplasia prevalence increases progressively from the apical zone (low), to the middle zone, to the cervical zone (highest) in both maxillary and mandibular canine teeth. Inter-specific variation in physiological stress and tooth-jaw morphology are hypothesized as etiological factors.

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Gonadal-Immune Interactions in Two Populations of African Men. W. LUKAS, Boston University, Boston MA 02215.

Men have greater muscle mass but lower immune-competence than women due to differing levels of gonadal steroids. Testosterone (T) and immune cytokines have mutually modulatory actions, many of them inhibitory. These actions may serve to reallocate energy between immunity and reproductive function. Trade-offs between reproduction and immunity should be stronger under conditions of high nutritional stress.

The cytokine IL-1 beta plays a major role in immune activation, tissue homeostasis, and modulation of gonadal hormones. IL-1 activates lymphocytes, promotes catabolism of skeletal muscle, and inhibits LH secretion and testis steroidogenesis. This project will attempt to determine whether level of IL-1 is related to T, LH, and muscle mass in Zimbabwean and Turkana men, two African populations subject to different levels of nutritional stress.

Blood spots and urine filter paper samples from 284 Turkana men and urine filter paper samples from 109 Zimbabwean men will be analyzed for IL-1 and LH using ELISA. Hormones previously measured include serum T and LH from the Turkana sample and salivary T from the Zimbabwe sample. Standard anthropometric measurements have been recorded.

It is predicted that IL-1 will be significantly and negatively correlated with T, LH, fat-free mass, and upper arm muscle

plus bone area. These correlations should be stronger in the Turkana, who are more nutritionally stressed. If these predictions are confirmed, a consistent interpretation is that IL-1 has effects on the gonadal axis and skeletal muscle that serve to reallocate energy from reproductive to immune function. The impact of immunity on reproductive function has implications for understanding patterns of male life history and contribution to fertility variation both within and between populations.

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Fecal Cortisol Levels and Sociosexual Behavior in Wild Male Capuchin Monkeys (*Cebus apella*). J.W. LYNCH¹, T.E. ZIEGLER² and K.B. STRIER¹. ¹Department of Anthropology, University of Wisconsin, Madison WI 53706. ²Wisconsin Regional Primate Research Center, Madison WI 53711.

Fecal cortisol has been used as a marker of stress in both captive and wild primates. In this study, fecal samples were collected opportunistically from six males in one group of wild tufted capuchins (*Cebus apella nigratus*) from September 1996 through August 1997 at the Estação Biológica de Caratinga, Brazil. Samples (n=209) were analyzed for cortisol level using enzyme immunoassays (ELISAs). Cortisol levels, compared across seasons and individuals, were analyzed in relation to both social and ecological factors.

Males were classified as being adult (n=4) or subadult (n=2). Rank was clear for the alpha male, but the dominance order among other adult males was indeterminate. The alpha male displayed the highest mean level of cortisol, and the subadult males had the lowest (ANOVA, $F=3.01$, $p<0.01$). All males showed a significant sustained increase in cortisol levels during the mating peak in the month of May (ANOVA, $F=12.98$, $p<0.001$); however the adult males showed a sharper increase than the subadult males. Brief increases in individual cortisol may be related to particular stressors, such as re-entry into the social group, intergroup encounters and aggression. Ecological factors such as diet, rainfall, and photoperiod may have less effect than predicted on capuchin cortisol levels.

Previous reports of tufted capuchin sexual behavior have described the alpha male as a passive recipient of female sexual interest, and subordinate males as largely non-competitive for mating opportunities. The cortisol results found here suggest, in contrast, that when females display seasonal proceptive behavior, all males in the group may become highly stressed by the ensuing mate competition. In addition, comparing these capuchin results to hormonal profiles of sympatric male muriquis (*Brachyteles arachnoides*) studied during the same time period provides insights into the interaction between social organization and endocrinology.

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Dental evidence of health in African-born and American-born children. M.E. MACK, M.L. BLAKEY, Howard University, Washington, DC 20059, and A.H. GOODMAN, Hampshire College, Amherst, MA 01002.

In reconstructing the health profiles of past populations teeth provide an indelible record of an individual's childhood health status. This study presents enamel defect (enamel hypoplasia) data comparisons for 141 positively aged and sexed adults and 90 positively identified subadults who comprise part of the excavated remains from the New York African Burial Ground.

Comparisons of adult and subadult enamel hypoplasia frequencies and number of occurrences per individual show that subadults were affected by significantly higher rates of enamel hypoplasia than adults. Along with corroborating historical documentation these results suggest that children born in Colonial New York lived in a more physiologically stressful environment than the more African-born adults.

Comparisons of enamel hypoplasia frequency among adults exhibiting dental modifications, those adults without dental modifications and subadults demonstrates a clearer pattern of stressful episodes for subadults, adults without dental modifications, and those with dental modifications respectively. Historical and anthropological evidence suggest dental modification is associated with African natality and childhood. The relation of these data to isotopic analysis will be discussed. Our results suggest adults exhibiting dental modifications were born and raised in a healthier African environment than their American-born counterparts.

Social interactions between wild infant and adult male white-faced capuchin monkeys (*Cebus capucinus*). K.C. MACKINNON, Department of Anthropology, University of California, Berkeley, CA 94720

As part of a larger study on *Cebus capucinus* immature social development, I examined interactions between infants of both sexes and adult males in two social groups of capuchins in the distinctly seasonal tropical dry forest of Santa Rosa National Park, Costa Rica. Approximately 400 hours of data were collected in the form of ten minute focal samples, using a behavioral repertoire designed for this study. Spatial association patterns were determined from spatial proximity scores (to the focal animal) at the beginning and end of each ten minute focal sample. In general, *C. capucinus* infants in the wild are classified as "dependent" from birth to 6 months, and "independent" from 6 months to one year, although there is variation in development patterns. I documented the range of affiliative behaviors between infants and adult males, including what factors drew the attention of the infants to the adult males, and vice versa, and the effect the infants have on their social interactions with adult males in the social group.

In this presentation, I will focus on the influence of the mother's sexual behavior on interactions between the infant and specific adult males. In addition, certain adult males show preferences for interacting with specific adult females, in terms of grooming and proximity rates. This directly effects the frequency and kinds of interactions between adult males and infants.

The continuum of nonhuman primate male involvement in the lives of immature animals ranges from extensive

caretaking at one end, through various affiliative behaviors including play, to tolerance and indifference, and finally aggression at the extreme end. In *C. capucinus*, adult males are a source of great interest to the younger animals. Infants watch, follow, play near, on, and sometimes with adult males. Overall, young animals monitor where the adult males are and what they are doing.

The results indicate that there is much variation in infant-adult male social interactions, and that these interactions are influenced by the dominance rank of the adult males and group composition factors (i.e. age/sex classes). Analyzed data will be discussed in light of hypotheses that are commonly invoked to explain such behavioral interactions in nonhuman primates: kinship recognition and kin selection, and the acquisition of social skills. Supported by a grant from the National Science Foundation.

The evolution of the dentate nucleus in Hominoidea. C.E. MACLEOD, K.ZILLES, A. SCHLEICHER, and K.R. GIBSON, Department of Archaeology, Simon Fraser University, Burnaby, BC, Canada V5A 1S6, C. & O. Vogt Institute of Brain Research, Heinrich Heine University, Duesseldorf, Germany; Department of Basic Sciences, UT Dental Branch, Houston, TX 77225.

The dentate nucleus is the output nucleus for the neocerebellum, which dominates the cerebellar hemispheres in higher primates. Research now suggests neocerebellar participation in planning of motor activities, sensory discrimination, visuo-spatial cognition, and even language in humans. Matano and Hirasaki (1997) see the dentate nucleus as a progressive structure that has expanded dramatically in hominids, and that this expansion may be a key to understanding the development of higher cognitive functions in the hominid line. However, the measure of the volume of the dentate nucleus, in a substantially larger representation of hominoids than that of Matano, would indicate otherwise.

The dentate and principal inferior olivary nuclei, as well as the volume of the whole brain, cerebellum and cerebellar hemispheres, were measured from histological sections in 21 apes, 8 humans, and 18 New and Old World Monkeys. Monkeys have the highest ratio of dentate volume to hemisphere volume, apes have less, and humans have the smallest dentate ratio of all primates measured. Although the dentate nucleus is large in humans when compared to body weight in logged multiple regression, it has not expanded at the same rate as the hemispheres or the cerebellum.

By contrast, the cerebellar hemispheres have expanded disproportionately to the vermis and to the rest of the brain in hominoid evolution, indicating an increased capacity of the cerebellar CORTEX for processing information relevant to primate intelligence. The volumetric evidence does not point to an augmented role of the dentate nucleus in human evolution. Instead, a jump in neocerebellar processing power took place with the evolution of the hominoids.

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Marriage patterns, admixture estimates and *Fst* statistics in two ethnic groups in Limón, Costa Rica. L. Madrigal, B. Ware and R. Miller. Department of Anthropology. University of South Florida. Tampa, FL 33620

The study of subdivided populations has been of interest to biological anthropology. The purpose of this paper is to report the admixture estimates, *Fst* values, and isonymy of two groups, which inhabit Limón, Costa Rica. Blood samples were obtained from a total of 375 individuals. The samples were analyzed for hemoglobin, G-6PD and GcI, Bf, ACP, PGM1, and PLG. The subjects were also interviewed, and asked to ethnically/racially classify themselves. The only two terms chosen by the subjects were Black (246 individuals) and White (129 individuals). The subjects' two surnames were analyzed to determine the ethnicity of their parents. In Costa Rica, individuals carry their father's and mother's first surnames. However, if an individual does not have a legally-acknowledged father at birth, he/she carries his/her mother's first surname, but twice. Thus, "illegitimate" children have isonymous last names. We use Crow and Mange's (1965) formulae to compute the total inbreeding (*Ft*), the non-random inbreeding (*Fn*), and the random inbreeding (*Fr*). The total inbreeding is much higher in the Afro-Limonense (*Ft*=0.07) group than in the Hispanic one (*Ft*=0.03). We interpret these high *Ft* values as measuring not inbreeding, but illegitimacy as a result of the high prevalence of out-of-wedlock matings in the Afro-Limonense community. Admixture estimates were computed for both groups using the computer program ADMIX.PAS kindly provided by Jeffrey Long. The estimates for the Hispanic-Limonense group are 0.5866 European, 0.3383 Amerindian, and 0.0751 African ancestry. For the Afro-limonense group, the admixture estimates indicate 0.1047 European, 0.1357 Amerindian and 0.7595 African ancestry. The *Fst* values computed with the ADMIX.PAS program are *Fst*=0.00558 for the Hispanic group and *Fst*=0.05137 for the Afro-Limonense group. These *Fst* values indicate that the Afro-Limonense group has experienced more genetic drift than the other group. We conclude that although the two ethnic groups, which make up Limón's population do exchange genes, they have remained distinct breeding populations.

Context of mtDNA variation in populations from the Columbia Plateau. MALHI R.S., Dept. of Anthropology, University of California at Davis, CA 95616.

Native American mitochondrial DNA contains polymorphic regions, consisting of a gain or loss in restriction sites or the presence of a nine base pair deletion. These mutations characterize at least five distinct lineages (haplogroups) widely represented in populations of the Americas. Linguists and archaeologists have hypothesized that the Algonquian speaking inhabitants of Eastern North America migrated there from the Columbia Plateau 4000 yBP or earlier. After this eastward migration, the Columbia Plateau populations were replaced by

proto-Penutian speaking groups. Modern Native American populations residing on the Columbia Plateau are significantly different in their haplogroup frequency distribution from Great Lakes and Northeast populations.

Ancient DNA was extracted and haplogrouped from tooth and bone samples from archaeological sites found in different geographic/linguistic regions of the Columbia Plateau ranging from 200 - 6500 years in age. The samples were sufficiently clustered in time and space to be considered populations for the purposes of this study. The haplogroup frequency distribution of these populations were then analyzed and compared to modern Algonquian speaking and other populations. The results of this study provide insight into the occurrence and timing of this prehistoric migration and into the prehistory of populations from the Columbia Plateau.

Conflict and post-conflict behavior in small group of chimpanzees (*Pan troglodytes*). N.M. MALONE¹, L.L. VAUGHAN¹, and A. FUENTES², ¹Dept. of Psychology and Chimpanzee and Human Communication Institute, ²Dept. of Anthropology, Central Washington University.

Conflict and post-conflict behavior were recorded for a small group of socially housed chimpanzees over four six-week periods since the summer of 1997. A total of 690 hours of observation has resulted in a substantial post-conflict (PC) and matched control (MC) data set. Focal animal sampling was used to record both solitary and social behaviors. The use of the PC/MC method provides the ability to correct for baseline levels of behavior and affiliation, and identify behavioral trends. Chi-square goodness of fit tests were performed for every behavioral category for the whole group and by individual to determine if conflict has an impact on baseline levels of behavior. Our results demonstrate both some overlap in significant post-conflict behavior at the group level (grooming, display, threat and travel behaviors) and individual differences. Inter-individual proximity data, before and after each conflict, were also collected and analyzed for each chimpanzee. A comparison of the four data collection periods demonstrates the chimpanzees' tendencies to maintain visual contact and closer proximity after conflicts. Each chimpanzee's impact on group totals for reconciliation, consolation, and redirection are presented. We report corrected conciliatory tendencies ranging between 0% and 21.1% for the four data collection periods. The redirection of aggression towards humans during the post-conflict is also examined, as this has been shown to be a significant finding during the study ($X^2 [df=1] = 13.091, p < .01$). These data suggest a strong need for continued long-term studies to be conducted following comparable methods, and prompt the investigation of captive environments and caregiver philosophy on the impact of conflict and post-conflict behavior.

Determination of human adult stature and foot length from the length of the third metatarsal. K.A. MANLEY-BUSER, Anatomy/Pathology Department, and J.L. BHATTI, Office of Graduate and Undergraduate Studies, Palmer College of Chiropractic, Davenport, IA 52803.

The identification of clues to an individual's stature, sex, and weight is essential to forensic medicine and biological anthropology. In some studies, it is also helpful to be able to determine total foot length from pedal elements. In this study, the relationships of third metatarsal length to foot length and to body stature were investigated, through the use of radiographs.

Data for this study were gathered from 125 adult patient records of the Palmer Chiropractic Clinic. Foot radiographs were corrected for magnification and stature measurements were adjusted where recorded age was over 30 years. Length of the third metatarsal was measured from an oblique-view radiograph, whereas osseous and straight foot lengths, as well as the angle of the longitudinal arch, were measured from a lateral-view radiograph. Patient age and stature were collected from the patient records.

This study found a strong correlation between third metatarsal length and osseous foot length, as well as between third metatarsal length and straight foot length and between third metatarsal length and stature. Bivariate regression analyses indicate a positive linear relationship between third metatarsal length and foot length and between third metatarsal length and height. There is only a weak correlation between longitudinal arch angle and straight foot length; no correlation was found between longitudinal arch angle and either weight or height.

Third metatarsal length can be used to estimate body stature and foot length. Further research is being conducted to investigate the relationships among these variables during ontogeny, in both humans and pongids.

PIXE analysis of trace elements in pre-Columbian Tlatelolco teeth and the relationship to colored teeth. Diagenetic alterations or traumatic events? J. MANSILLA¹, C. SOLIS² and M.E. CHAVEZ, ¹Dirección de Antropología Física, INAH, Mexico City, D.F. 11560 ² Instituto de Física, UNAM, Mexico City, D.F. 04510.

Archaeological well-preserved teeth taken from pre-Columbian adult and sub-adult skeletons from Tlatelolco were analyzed by PIXE. Trace elements in enamel were obtained.

This paper reviews the occurrence and implications of a high concentration of

manganese and iron in the deciduous teeth compared to the adult teeth. A difference of appearance in these deciduous teeth was observed, the crown has a grayish coloration visible by external inspection.

We discuss the forensic cases of colored teeth due to an increment of iron that have been reported as the hemoglobin product of a highly traumatic action, and also the possible diagenetic alterations of the burial environment that a thinner enamel in the deciduous teeth may produce.

Taphonomy of a Large Collective Tomb from a Bronze Age Population from Tell Abraq, United Arab Emirates. M.M. MARGOLIS, Anthropology, Fort Lewis College, Durango, CO 81301, D.L. MARTIN, P. K. STONE, M. J. KENNIS, and A. M. MICKOWSKI, Natural Science, Hampshire College, Amherst, MA 01002

Excavation of a large Umm an-Nar tomb at Tell Abraq revealed a great quantity of disarticulated and commingled human remains representing at least 250 individuals. The tomb was used over a 300-year period (2000-2300 B.C.) and the remains are in relatively good condition although most are partially broken. All age categories are well represented, from fetal and newborn remains to individuals aged sixty and older. The demographic profile by age categories suggests a well represented Neolithic population with approximately half of the individuals aged below 18. Some unique features of this skeletal population include an extreme range of variability in size and robusticity among the long bones in particular. Individuals range from small and gracile to large and robust.

A detailed taphonomic study of the tomb revealed that bones were not distributed equally in the tomb. Although many of the skeletons were completely disarticulated, some partially articulated individuals were located near the top and sides of the tomb and in the passage way between the two chambers. The arrangement, preservation, and location of the skeletal elements suggests that burials were interred over time by placing individuals inside the tomb while simultaneously pushing previously interred individuals to the sides and back of the tomb. The breakage pattern suggests that primarily large bones were the most broken, with smaller rounder bones being better preserved. Taphonomic analysis revealed some unusual mortuary behavior regarding how burials were moved around inside the tomb. The mortuary rituals likely to have accompanied the use of this tomb are discussed.

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The Lower to Middle Paleolithic Shift in Europe: Continuity, Replacement or Diffusion.

ANTHONY E. MARKS, Department of Anthropology, Southern Methodist University, Dallas, TX, 75275.

While the Lower and Middle Paleolithic of Europe each may be defined as a period, the transition from one to the other was never a sharp break in technological or typological patterns in any part of Europe and Eurasia. In fact, the specific recognized differences between the Lower and the Middle Paleolithic tend to be clearly seen only at the temporal extremes of each: the Early Lower Paleolithic vs. the Late Middle Paleolithic. Some diffusion or even movement of peoples out of Africa may be seen but, invariably, these fell within the early to middle stage of the Lower Paleolithic. There is virtually no indication of any diffusion or movement of new technological or typological patterns from Africa during the shift from the Lower to Middle Paleolithic. A comparison of the geographically adjacent Levant and Northeast Africa clearly documents major differences which temporally span the period of shift. The addition, in both Iberia and Western Eurasia, there is ample evidence for local continuity from the Lower to the Middle Paleolithic. Thus, quite apart from the fossil record, there is no evidence for African influences during this complex transition.

The skeletal remains from a great medieval Portuguese battle. C. MARQUES, V. MATOS and E. CUNHA, Departamento de Antropologia, Faculdade de Ciências e Tecnologia, Universidade de Coimbra, 3000-056 Coimbra, Portugal.

In 1385 a famous battle between Portugal and Castilians took place in Aljubarrota, central Portugal. This was of crucial importance to the maintenance of Portugal as an independent nation, separate from Spain. At least 400 individuals were recovered from a common mass grave in the battlefield excavated in the early sixties. The large grave consists of thousands of commingled and incomplete human bones. The main results are presented, focusing on questions of taphonomy, paleodemographic profiles and paleopathological issues. The sample is composed exclusively by males who were, in the majority, robust and middle-aged. Details of pathology confirm a high prevalence of traumatic injuries, especially those due to cuts and incisions from the

battle. These perimortem injuries are consistent with the historical details concerning the reason for the mass grave. Infectious diseases are also frequent, mainly healed ones, and these indicate that some soldiers carried wounds from previous battles before their final demise at Aljubarrota. In all, the anthropological analysis of this rare assemblage of bones contributes both to a better knowledge about the osteological consequences of hand-to-hand warfare and general information about males in the Middle Ages.

Expression of paranasal sinuses in New World monkeys:

Application to phyletic evaluation. S. MARQUEZ^{1,4,5,7}, P. J. GANNON^{2,5}, E. DELSON^{4,5,6,7}, T. C. RAE^{6,8}, T. KOPPE⁹, A. SILVERS³, W. LAWSON², and J. T. LAITMAN^{1,2,4,5,6}. Cell Biology & Anatomy¹, Otolaryngology², Radiology³, Mt Sinai School Med, NY; CUNY⁴, NYCEP⁵, AMNH⁶, Lehman College⁷, NY; Univ Durham, UK⁸; Institute of Anatomy, Univ Griefswald⁹.

Patterns of morphology represent an important component for understanding systematic relationships in primate evolution. In platyrrhines, for example, many components of craniofacial morphology have been utilized to assess phylogenetic relationships. One potentially important suite of craniofacial traits, however, has not received a similar level of attention, the paranasal sinuses (PNS) within the nasal complex. Although others have reported on PNS anatomy in platyrrhines using sagittally sectioned dry museum skulls, this technique cannot distinguish between PNS *sensu stricto* and other kinds of air chambers, such as enlarged cells of spongiform tissue. To properly evaluate PNS in New World monkeys (NWm), we used CT imaging to track their presence and distribution to assess the potential for application of PNS morphology to phyletic analysis.

A sample of adult dry crania (n=55), representing 20 species from 16 genera of NWm was obtained from the American Museum of Natural History, the Natural History Museum (London) and the University of Griefswald (Germany). PNS identification, description, and quantification was performed with multiplanar reformatting and virtual 3D reconstructions based on CT scans obtained with GE HiSpeed Advantage and Siemens DTR scanners using helical fast track evaluation. All platyrrhine crania possess definitive maxillary sinuses, but frontal and sphenoid sinuses were variably expressed. Surprisingly, four genera *Callimico*, *Cebus*, *Callicebus* & *Alouatta* exhibit ethmoid sinuses; previously, the ethmoid sinus had been demonstrated to be present only in great apes and humans (Marquez et al., 1999).

This study shows that, unlike other methods, CT imaging easily discriminates between PNS and other pneumatizations. Since the nasal complex is a highly conservative region in primate evolution, variation in NWm PNS expression may indicate environmental adaptations. In contrast to the phyletic pattern of differential PNS development in catarrhine clades, platyrrhines appear to present convergent evolution in isolated lineages. Alternatively, these features may represent isolated primitive retentions. These powerful imaging techniques allow a more complete appraisal of both PNS presence and magnitude, which contribute to our understanding of nasal complex function and evolution.

This work supported by NSF, NIH, NYCEP, Leakey Foundation and The Royal Society, UK.

Functional anatomy of the lumbar vertebral column in modern *Homo sapiens*, great apes and australopithecines. S.A. MARTELLI and P. SCHMID, Anthropologisches Institut, Universität Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland

In mammals, size and structure of lumbar vertebrae are correlated with locomotor behaviour. Utilising sagittal sections, the present study compares the lumbar morphology of modern *Homo sapiens*, the great apes, australopithecines (*Australopithecus afarensis*, AL 288-1, *A. africanus*, Stw 8, Sts 14 & 431, *Paranthropus robustus*, Sk 853) and *H. ergaster* (KNM-WT 15000) in order to determine traits that separate facultative or obligate bipedal species from quadrupeds, and to explain how these traits functionally contribute to the adaptations of bipedal walking.

The results of this study indicate that bipedal taxa are clearly separated from the quadrupedal great apes, with the australopithecines forming a well-defined functionally-related group compared to modern humans. Differences between taxa are highly size-correlated using raw data. However, size-independent data shows that the following traits discriminate bipedal species from quadrupeds: Length of the inferior processus articularis, angle formed by the origin of ligamentum flavum on the internal laminar structure, and the angle formed by the inferior processus articularis against the sagittal line through the posterior side of the vertebral body. These traits primarily contribute to variation in the size of the lumbar lordosis, and the degree of relative degree of bending and rotation between individual vertebra. The importance of these traits highlights the general role of the lumbar vertebral column as an important driving element in bipedal locomotion, working as a kinetic transport element.

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Strong Women in Marginal Places: Rates of Morbidity and Mortality for Ancestral Pueblo Populations. D. L. MARTIN, P. K. STONE, M. BARR-DICHIARA, Hampshire College, Amherst, MA 01002, and S. BURGDORF, Mount Holyoke College, S. Hadley, MA 01035

An impressive wealth of data exists for many aspects of Southwest precolonial history but what has been lacking from this literature is an integrated and multifactorial analysis of patterns of morbidity and mortality for young adult men and women. Many studies report that the rates of morbidity and mortality in early and historic populations are consistently higher for women, and this higher risk has been linked to the biological rigors of pregnancy, birth and lactation. Other studies have challenged these notions suggesting that women are resilient and adaptable and that

reproduction may not have played a significant role in early mortality.

This study tests hypotheses drawn from these arguments. Specifically, we examined data collected from a large (n=195) homogeneous population from the archaeological site of Black Mesa in Arizona (A.D. 900-1150). Data were collected on age-at-death, frequencies of pathology, stature, obstetrical dimensions and pelvic morphology, bone cortical thickness, occupational stress markers in the arm-hip-leg complexes, availability of medicinal plants, ethnohistoric information on reproduction and diet, and archaeological reconstruction of settlement patterns and political-economic processes.

This study reveals that a subset of women were at risk for early death due to a complex suite of factors, each playing a significant role in limiting the ability to rally from health problems and to withstand a number of physiological stressors. For example, rates of nutritional anemia and infection are similar for males and females, but females at risk for early death have more pronounced cases and these co-occur with other indicators of biological stress, such as smaller birth canals. Women who live past the age of thirty-five demonstrate robust skeletons and marked muscularity.

This research was supported by a Hampshire College Howard Hughes Medical Institute Award.

Public and private genetic modulations of the pathobiology of senescence. G. M. MARTIN, Departments of Pathology and Genetics University of Washington, Seattle, WA 98195.

Most human geneticists interested in aging have been preoccupied with rare constitutional mutations that lead to the premature onsets and/or accelerated rates of development of diseases that typically escape the force of natural selection. The frequencies of these idiosyncratic "private" mutations are ~10⁻⁶ and their prevalence in any population is largely a matter of founder effect and drift. These can be powerful entering points for basic biochemical mechanisms of aging as they occur in most of us. On the other hand, they may reflect rare mechanisms of decline in function. Increasing attention is therefore being given to the roles of common polymorphisms (frequencies >10⁻²). These may include many alleles that have been selected for enhanced early fitness. Accordingly, they may lead to knowledge of more "public" mechanisms of aging, in the sense that they may reflect relevant gene actions common to many populations of humans, species, or, conceivably, all species. As a test of the degree to which both "private" and "public" genetic modulations can converge on common major mechanisms for the genesis of a major late life disorder, our laboratory has used knowledge of gene action revealed by the rare autosomal dominant forms of dementia of the Alzheimer type (DAT) as a guide for research on polymorphisms that impact upon the common late onset "sporadic" forms of DAT. These results support variations in the metabolism of the beta amyloid precursor protein as a central mechanism. We have also begun a series of

investigations on the role of polymorphisms at the Werner locus for age-specific susceptibility to atherosclerosis. These studies could potentially lead to the discovery of alleles that lead to enhanced function of the cardiovascular system during later life. There is currently great interest in determining associations between polymorphisms and unusual longevity ("healthy" centenarians). Interesting loci might thus be identified in certain well-defined populations, but there are major conceptual and technical difficulties. Here I shall argue that we can make more rapid progress by a genetic analysis of "elite" aging for a host of very specific phenotypes, as these are more likely to be under the control of a much smaller number of major loci.

Variation in menstrual cycle length and cessation of menstruation in captive raised baboons. LJ MARTIN, KD CAREY, AG COMUZZIE. Southwest Foundation of Biomedical Research, San Antonio, TX 78227.

The World Health Organization defines menopause as the absence of menstruation for 12 months not due to any other medical condition. Cessation of menstruation has been observed in both human and non-human primates. However, whether non-human primates experience "true" menopause is controversial. Much of this controversy arises over the fact that in wild populations not all non-human primate females will display a clear cessation of menstrual cycling, however, this may result from a truncated life span due to disease or predation. Regardless of whether non-human primates experience clinical menopause, captive colonies of primates could provide a unique model to examine the physiological changes associated with increasing cycle variability and the ultimate cessation of menstruation. Therefore, the purpose of the present study was to characterize the menstrual cycle variability in the baboon colony at the Southwest Foundation for Biomedical Research. For these preliminary analyses, cycle lengths for female baboons aged 15 years or younger were compared to the cycle lengths of females baboons aged 20 years or older. Using Bartlett's test of homogeneity of variances, older females had significantly greater cycle variability than younger females ($p < 0.000001$). Additionally, a sample of females aged 20 years and older was examined to determine if their cycles were characteristic of menopause or peri-menopause based on turgescence data and menstrual cycles for one year. Based on the criteria for humans, a female baboon was considered menopausal if she had no menstrual cycles for one year. Likewise, if a female experienced irregular cycles and or irregular turgescence patterns, she was considered peri-menopausal. Out of 47 female baboons aged 20 years or greater, 6 were menopausal and 17 were peri-menopausal. The youngest menopausal baboon was 23.43 years old while the oldest peri-menopausal baboon was 28.92 years old. Clearly, baboons experience substantial variation in the timing of the cessation of menstruation. Through an examination of the age of onset in menstrual cycle variability and cessation of menstruation in baboons, this research demonstrates that baboons may provide an important model for the study of human menopause. This research was funded in part by NIH grant HL28972.

Geographic variation in the crania of *Cebus albifrons*. T.J. MASTERSON, Department of Health Promotion and Rehabilitation, Central Michigan University, Mt. Pleasant, MI 48859.

This study examines geographic cranial variation among nine subspecies of *Cebus albifrons* by means of ANOVA, Tukey's multiple comparison test, multivariate discriminant function analysis, and multivariate cluster analysis. Only adult specimens are used in this study. Sample sizes range from 30 to 6 specimens per subspecies. The analyses are based on 23 linear variables. Each specimen is assigned to a subspecies according to its location of capture. Geographic ranges for each subspecies are taken from published sources.

Results of the analyses of variance indicate that the nine subspecies are significantly different in all cranial variables except alveolar height, biorbital width, orbital width, and orbital height.

Tukey's tests indicate that *Cebus albifrons yuracus* and *C. a. unicolor* possess significantly larger dental arcades, increased prognathism, and the largest absolute cranial size compared to *C. a. versicolor*. Other significant differences are present; however, the patterns are more complicated.

Discriminant function I differentiates the subspecies by overall size. The larger subspecies (*C. a. yuracus*, *C. a. cuscinus*, *C. a. aequatorialis*, *C. a. malitiosus*, *C. a. unicolor*) are differentiated from the smaller subspecies (*C. a. albifrons*, *C. a. cesarae*, *C. a. versicolor*, *C. a. trinitatis*) by variables related to the dental arcade, prognathism, and neurocranial shape. Function II further differentiates the larger subspecies from each other by variables related to facial height, facial width, and neurocranial shape; however, some overlap is present.

Cluster analysis illustrates that the subspecies are clustered into two main groups. The first group contains subspecies that are smaller in size. *Cebus a. cesarae* and *C. a. albifrons* join first and are then joined by *C. a. versicolor*. *Cebus a. aequatorialis* and *C. a. trinitatis* join this group consecutively. In the cluster of larger subspecies, *C. a. yuracus* and *C. a. cuscinus* join first, followed by *C. a. malitiosus* and *C. a. unicolor*. The large and small subspecies groups then join forming the root of the *C. albifrons* tree.

The results of this study, in conjunction with molecular and morphological analyses examining the relationships both within and among the other capuchin species, support the proposal that the taxonomy of *Cebus* needs some revision.

Death and the mother's hand: The nature of children's burials. R.A. MATHIS, Department of Anthropology, University of Massachusetts, Amherst, 01003.

This paper will explore the range of funerary practices surrounding children's burials and underlying ideologies regarding infants and children in the eighteenth century. Culture and ideology lie at the center of burial practices. The analysis of children's burials is an opportunity to explore the underlying structure of culture and ideology, particularly in regards to notions of family, gender status, and stratification.

Since it is the living that ultimately decide the fate of the deceased, an examination of the control and responsibility over children's burials is addressed. Historical and archaeological data from eight African, Dutch and English burial grounds (a total of 300 children's burials) are examined in regards to notions of family, gender status, and social stratification. Preliminary analysis indicates that children's burials were utilized by both men and women as symbolic markers of status and displays of resistance to dominant social hierarchies.

Shades of gray: bridging the gap in the repatriation controversy. A.T. MAYES, Department of Anthropology, University of Colorado, Boulder, CO 80309

Guilt, fear, power, politics, legitimacy, science, religion, DENIAL. All of these are words that could be used to describe those involved on both sides of the debate dealing with the repatriation of Native American burials and associated funerary objects. Ten years ago, even five years ago, the debate was so heated that one could not even call it a debate; an explosion is more accurate. But, as the smoke settles, patience and understanding on both sides have allowed for many productive exchanges, and, whether the scientists or the tribal groups have come to appreciate it or not, these exchanges have allowed for growth on both sides. Many are finding that a debate fired by deep beliefs, whether they be scientific or religious, may never be black or white, but shades of gray.

The initial reaction by many to the Native American Graves Protection and Repatriation Act (Public Law 101-601) was that skeletal biology would become non-existent, and that the law was written in such a way as to only benefit tribal groups. However, as the NAGPRA Law indicates, it does not discard anthropology, but, instead, encompasses it, giving the anthropological approach a defining voice in determining cultural affiliation of prehistoric groups, and allowing for an area of commonality between tribal groups and the scientific community.

Rising out of the social unrest of the 1960's and 1970's, the repatriation movement has been a turbulent path for all. Interpretations within each camp have been just as varied as between. Many tribes have used anthropologists and their information to support their positions as well as implement future policies. Anthropologists have been forced to justify their research both to tribal communities and the general public, discussing why collections continue to be of scientific value as theories and technology advance, and the benefits of this knowledge to present-day and future groups. Skeletal analysis and archaeological analysis document a history that may not otherwise be written.

There are moderates on both sides and, as the benefits of skeletal analysis are made clear, many Native Americans also see the potential of osteological analysis. Whether they be questions of nutrition, disease, or populational history, it would seem we may have found common ground after all.

Facial projection and the origin of modern humans. B.M. McBRATNEY, R.C. McCARTHY, and D.E. LIEBERMAN, Doctoral Program in Hominid Paleobiology and Department of Anthropology, The George Washington University, 2110 G Street, NW, Washington, DC 20052

Humans are unique among mammals in having faces tucked entirely underneath the anterior cranial fossa. Archaic *Homo*, including Neanderthals, are characterized by varying degrees of facial projection. Reduction in facial projection is most likely due to ontogenetic differences in the growth of the cranial base and the face. However it is not yet clear what precise mechanisms are responsible for these differences and, hence, the origin of modern human cranial form.

This study uses geometric morphometric analysis to test several hypotheses about the developmental bases for reduced facial projection in human evolution. A number of midsagittal and parasagittal craniometric points were digitized from radiographs and CT scans of a cross-sectional sample of *Pan troglodytes*, a longitudinal sample of *Homo sapiens*, and samples of early "anatomically modern" *H. sapiens* and archaic *Homo* sp. fossil crania. These data allow assessment of the variable effects of facial length, anterior cranial base length, posterior maxillary (PM) plane position, and cranial base angulation on facial projection and overall cranial shape. Partial warp analyses were performed to assess which aspects of size-adjusted cranial shape were responsible for ontogenetic changes in facial projection in humans and chimpanzees, and to compare the relative effects of these dimensions in adult modern humans, chimpanzees, early "anatomically modern" humans and archaic *Homo*. A principal components analysis was also conducted to assess the relative contribution of different inter-landmark distances on facial projection in these samples.

Results indicate that the primary determinants of facial projection in *Pan* and *Homo* are cranial base angulation, (extension in *Pan*, flexion in *Homo*), facial elongation (great in *Pan*, reduced in *Homo*), and the position of the PM plane relative to the anterior cranial base. These results are applied to comparisons of adult crania of archaic and early modern humans. Archaic *Homo* crania are found to have more projecting faces than those of early anatomically modern humans largely because they have more extended cranial bases. The implications of these results are discussed in relation to hypotheses about the origin of modern humans.

Multivariate morphometry: advantages of direct analysis of 3-dimensional coordinates of the human skull referred to functionally important planes.

D. G. MCBRIDE and R. A. BENFER, JR., Department of Anthropology, University of Missouri-Columbia, Columbia, MO 65211

Three-dimensional coordinates of landmarks contain more information than distances and angles among landmarks. Where referred to functionally important planes, such as the Frankfurt, Mid-Sagittal, and Coronal planes of the skull, their analysis becomes directly interpretable in terms of cranial morphology. A simple method of obtaining these

coordinates that requires only sliding and spreading calipers has long been available (Benfer 1972, Page 1974, Benfer 1975). Distances computed from the coordinates are comparable to classical measurements for nearly all landmarks; interobserver bias is more easily detected (Page 1976).

One unexpected finding of direct multivariate analysis of the coordinates is that the patterning of the superior extent of the face above the Frankfurt Plane did not correlate with the pattern of variation of facial landmarks below that plane. Another surprising result was the finding that the anterior variation of the face and frontal bone were unrelated to posterior variation in the occipital bone.

Here we present coordinate data from 48 crania from prehistoric Peru and 19 crania from the Neolithic of northeastern China. The samples range in age between 1,500 and 9,000 radiocarbon years. Principal component scores were analyzed by analysis of variance for the factors sex, age at time of death, age of series, and geography.

Although any three points may be used as reference points for measurements to a landmark which can be used to calculate a set of coordinates, we argue that referring these points to functionally important planes produces a more interpretable morphometry.

Separating the baby from the bathwater: Facial vs. neurocranial characters and the origin of modern humans. R.C. McCARTHY, Doctoral Program in Hominid Paleobiology, The George Washington University, 2110 G Street, NW, Washington, DC 20052

Large braincases evolved early in the Late Pleistocene so that neurocranial features tend to be primitive for hominids during this time period. As a consequence, multivariate analyses using neurocranial variables tend to support the Multiregional Model (MRM), whereas those that use facial variables tend to support the Single Origin Model (SOM).

To investigate the problem of trait list bias, I partitioned 29 of Howells' measurements into neurocranial variables (n=15) and facial variables (n=14). Canonical Variates Analyses (CVA) were then used to establish the patterns of evolution for neurocranial and facial characters among 28 modern human populations and 23 fossil specimens. Differences between data sets were evaluated by comparing UPGMA-clustered Mahalanobis distances as well as evolutionary rates (see Bilsborough, 1973). Finally, discrete character states were created for each character using homogeneous subset coding, and cladograms were generated using ordered characters.

The CVA and evolutionary rate analyses indicate that neurocranial characters group together Upper Paleolithic, Mesolithic and modern humans. In contrast, facial variables retain archaic features for a longer period, imply larger distances between modern, Upper Paleolithic and Mesolithic human groups, and link together Neanderthals and Lower Paleolithic hominids. These two groupings are not equally informative phylogenetically. Analysis of the data suggests that a large brain and correspondingly large neurocranium are symplesiomorphic features for all Late Pleistocene hominids, whereas facial characters retain synapomorphic

states during the Late Pleistocene and are therefore more appropriate foci for phylogenetic analyses. Cladistic analyses of neurocranial and facial datasets provide more consistent results than do phenetic analyses because they discriminate between symplesiomorphies and synapomorphies.

Neurocranial and facial variables evolved at different rates in Late Pleistocene hominids, and this information can only be evaluated adequately using cladistic analyses. The MRM is weakened in light of its support by characters that are symplesiomorphic for Late Pleistocene hominids.

Locomotor diversity among large-bodied hominoids from the middle Miocene of Africa. M.L. McCROSSIN and B.R. BENEFIT, Southern Illinois University, Carbondale, IL 62901

Postcranial remains are known for two genera of large-bodied hominoids from the middle Miocene of Kenya:

Kenyapithecus (McCrossin, 1994; McCrossin & Benefit, 1994, 1997; McCrossin et al., 1998) and *Nacholapithecus* (Nakatsukasa et al., 1998; Ishida et al., 1999). Initial ideas concerning the limb bones of *Kenyapithecus* and *Nacholapithecus* resulted in their interpretation as primitive, *Proconsul*-like forms (Rose, 1983, 1993; Andrews, 1992). Indeed, misinterpretation of the postcranial morphology of *Nacholapithecus* (Rose et al., 1996), contributed to an erroneous placement of *Kenyapithecus* from Maboko and *Nacholapithecus* in a single genus (Ward et al., 1999).

More recent and detailed analyses, however, have revealed that postcranial remains of *Kenyapithecus africanus* from Maboko Island and *K. wickeri* from Fort Ternan provide the earliest evidence of semi-terrestrial adaptations among African apes and humans. Adaptations for a knuckle-walking form of semi-terrestriality are seen in the following features of *Kenyapithecus*: 1) proximal extension of the greater tubercle above the head of the humerus, 2) posterior orientation of the medial epicondyle, 3) retroflexion of the olecranon, 4) development of a strong dorsal ridge on the distal radius, 5) presence of a metacarpal torus on the third metacarpal, and 6) short and straight phalanges. Evidence from the dentognathic morphology of *Kenyapithecus* indicates that adoption of a pitheciine-like diet and sclerocarp foraging strategy may have been the impetus for the origin of knuckle-walking adaptations among African apes and humans.

Reconstruction of the substrate preferences and positional behavior of *Nacholapithecus* initially yielded equivocal results (Rose et al., 1996) and it was unclear whether the large-bodied hominoid from Baragoi was primarily arboreal or terrestrial. Recent discoveries, however, clearly show that *Nacholapithecus* was adapted for enhanced vertical climbing in an arboreal milieu, with a medio-posteriorly directed medial epicondyle, straight olecranon, and long and slender phalanges (Nakatsukasa et al., 1998).

Body composition in a juvenile gorilla (*Gorilla gorilla gorilla*) compared to adult gorillas. R.K. McFARLAND, Cabrillo College, Aptos, CA 95003, and A.L. ZIHLMAN, University of California, Santa Cruz, 95064

Direct measurement of body composition in primates of any age, including humans, is extremely rare. Data on juveniles are virtually non-existent. Body composition data are essential for assessing health and growth and for comparing closely related hominoids to address questions of adaptation.

We dissected a healthy 3 year old captive female gorilla who died accidentally. We directly measured muscle, skin, bone, and fat and calculated their proportions relative to total body mass (TBM). The juvenile female has 36.3% muscle, 15.3% skin, and 16.9% bone. The values of muscle and skin are within the range of those obtained through direct dissection of three healthy adult gorillas (muscle 36.1 to 38% TBM; skin 13.2 to 16.9% TBM). The values for percentage of bone are slightly greater in the young animal (16.9% versus 10.2 to 13.2% in the 3 adults). The maximum possible amount of fat in the juvenile is 20%, within the range of the adults (maximum 19 to 26% TBM).

Direct assessment of body composition adds to our knowledge of gorilla growth and complements studies such as Schultz's on the skeleton. We have begun to establish a data base for assessing changes in body composition as animals age. Body composition, like all aspects of anatomy, is a product of evolutionary history and relates to locomotion, diet, and growth. Documentation and comparison of body composition in hominoids will contribute to further understanding of the ape-human transition.

Biogeography and evolution of the *Cercocebus* - *Mandrillus* clade. W.S. McGRAW, Department of Anthropology, The Ohio State University, Mansfield, Ohio 44906 and J.G. FLEAGLE, Department of Anatomical Sciences, School of Medicine, SUNY, Stony Brook, NY 11794.

Both molecular and morphological studies of papionin monkeys have confirmed the diphyletic nature of mangabeys. Specifically, it has been demonstrated that terrestrial mangabeys *Cercocebus* are the sister taxon of *Mandrillus*, while arboreal mangabeys *Lophocebus* are more closely related to baboons and geladas.

Terrestrial mangabeys of the genus *Cercocebus* are taxonomically diverse and

widespread. The six allopatric species (Kingdon 1988) range from Guinea (*C. atys*) through Cameroon and Gabon (*C. torquatus*) across central Africa north (*C. agilis*) and south (*C. chrysogaster*) of the Congo River, east to Tanzania (*C. sanjei*) and Kenya (*C. galeritus*). *Mandrillus* (mandrills and drills) are restricted to western central Africa from Cameroon south to Gabon.

Information from various sources bears directly on biogeographic and taxonomic questions among terrestrial mangabeys and mandrills. Nakatsukasa (1995) noted that *C. galeritus* limb bones were the most distinctive and least mandrill-like of the *Cercocebus* monkeys. Kingdon (1997) argues that *C. chrysogaster* possesses pelage markings and a muzzle morphology most similar to *Mandrillus*. Grubb (1978) put forth the most detailed hypothesis for the radiation of terrestrial mangabeys by constructing a hypothetical dispersal pathway for the primitive *Cercocebus* ancestor.

In this paper, we test these hypotheses using geographic and morphological data for *Cercocebus* and *Mandrillus*. In light of our results, we offer a biogeographic scenario for the evolution of the *Cercocebus* - *Mandrillus* clade.

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Ecological correlates of long-term stasis among African mammals of the Pliocene and Pleistocene. J.K. McKEE, Department of Anthropology, The Ohio State University, Columbus, Ohio, 43210.

The tempo and mode of hominid evolution can be assessed by comparing our ancestral species patterns in the fossil record to those of other mammals. Data on first and last appearances of fossil mammal species from East and South Africa were compiled to compare observable species longevity. 273 species from reasonably-well dated assemblages ranged in longevity from 10 kyr to 4.4 myr, averaging 1.3 myr. Hominids averaged 6.4 myr.

Many factors may affect the apparent longevity of a species, not the least of which is the inconsistent nature of the fossil record. Species which appear for short time periods tell us little, as much of their true longevity may have been missed by the fossilization and recovery process. On the other hand, given the dictum that "stasis is data," most species with long-term stability in the fossil record must reflect long periods of relative stasis, and can be compared for underlying patterns.

Species which appear in the fossil record for 2 myr or more fall into two main categories, both of which demonstrate the importance of ecologically-bounded demographics. The largest single group are the carnivores (14 out of 75 long-term species), which presumably do not reach high population densities. The remaining species are mainly suids, bovids and other artiodactyls, most of which share one characteristic: specific habitat

requirements which led to patchy and discontinuous geographic distributions. Thus vicariance appears to lead to stasis. In contrast, savanna grazers with wide distributions tend to be more evolutionarily volatile.

It is hypothesized that these data support an evolutionary model in which stasis is often a product of low population density (e.g. *Australopithecus afarensis*). More evolutionary volatility, such as seen among early *Homo*, would be an autocatalytic phenomenon generated by larger, widespread populations of ecologically generalized and/or well-adapted species.

Cranial Morphology as Evidence for Distinct Social Groups at the Leavenworth Site. A.H. MCKEOWN and L.W. KONIGSBERG, Department of Anthropology University of Tennessee, Knoxville

The Leavenworth site (39CO9), South Dakota, consists of two village areas occupied between 1804-1832 and a cemetery that is subdivided into 5 distinct burial areas designated A-E by Bass et al. (1971). Key and Jantz (1990) determined that the Leavenworth crania are more heterogeneous than those comprising a composite sample from several Bad River phase sites. Evidence for the presence of distinct social groups at the Leavenworth site includes linguistics, ethnohistorical accounts and archaeologically recovered ceramics as well as traditional metric analyses of cranial variation (Byrd and Jantz 1994). This research concluded that the historic residents of the Leavenworth villages were descendants of the preceding Bad River and Le Beau phase populations.

The present study re-examines the morphological variation present in crania from the Leavenworth site employing three dimensional coordinate data. Thirty-six landmarks were collected as Cartesian coordinates from the face and vault of crania from burial areas A, B and C of the Leavenworth site as well as the Le Beau phase components of 4 sites (Sully, Larson, Mobridge, Nordvold 1) and 4 Bad River phase sites (Indian Creek, Black Widow Ridge, Leavitt, Cheyenne River). Analysis of the three dimensional configurations includes superimposition, principal component analysis and discriminant procedures to ascertain the variation present between the Le Beau and Bad River phase crania as well as the affinities of the Leavenworth crania. The hypothesis that the spatially distinct burial areas at Leavenworth are the result of band associations is tested by using discriminant formulas generated with the Le Beau and Bad River phase samples to classify crania from each of the burial areas. The magnitude and direction of shape variation between the crania from the Le Beau and Bad River phase sites and their potential descendants among the Leavenworth sample are further investigated employing thin plate splines.

Historical and archaeological evidence of the origins of enslaved Africans in Colonial New York.

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Among the colonial cities on the British North American mainland in the eighteenth century, New York ranked second in the numbers of enslaved Africans who lived and labored there. Until the mid-eighteenth century, most of those imported came from the West Indies; after that time, many arrived directly from the African continent. Documentary evidence suggests extraction from a number of regions in Africa- the Guinea coast in West Africa, Congo and Angola in West-Central Africa, and limited importation from East Africa (including the Island of Madagascar). Although the nature of slaving operations complicates identification of African-New Yorkers ethnically, the interdisciplinary approach of the New York African Burial Ground Project illuminates the origins question. Preliminary genetic and craniometric results, combined with archaeological information from beads, marine shells, and coffin decoration, complement the documentary evidence of origins. These data suggest the centrality of certain African-born people and African mortuary practices at the New York African Burial Ground. This paper outlines what the project has learned about origins from the perspective of historical and archaeological data.

Fossilized footprints in the Ka'u Desert, Hawaii. D.J. MELDRUM, Dept. of Biological Sciences, Idaho State University, Pocatello, ID 83209-8007.

Fossilized footprints preserved in volcanic ash in the Hawaii Volcanoes National Park afford an exceptional opportunity to study traditionally unshod modern human footprints laid down under conditions relatively similar to those made by Pliocene hominids in east Africa. The footprint area encompasses about 8 square miles of the Ka'u Desert. It was traditionally believed that the footprints were left by the warriors of Keoua's army on their way to attack King Kamehameha, in 1790. The tale recounts that a great phreatic explosion from the Kilauea caldera killed nearly 1/3 of the attacking army. However, studies of the history of

the volcano's eruptions indicate that multiple explosions occurred over a period of time. There are at least two footprint-bearing ash layers separated by varying thickness of interbedded sands. Furthermore, the pattern and distribution of the footprints, which include those of women and infants, and identified archeological sites, suggest a more permanent occupation.

The tracks were photographed, including stereophotography yielding planimetric maps. In many instances footprint clarity and preservation are exceptional, revealing anatomical details of foot shape, toe conformation and arch development. They contrast with the Laetoli tracks in the marked development of the ball of the foot and toe pads indicative of differential weight bearing by these structures. There is consistent expression of a well-developed arch and no appearance of midtarsal flexion. Preservation of the ash layers is patchy throughout the footprint area, however several examples of tracks permit documentation of gait parameters. Scaled gait parameters are consistent with modern human samples and tracks exhibit dynamic features, such as comet tails, associated with a modern "stiff-legged" gait.

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Reconstructing the evolutionary history of Asian primates using mitochondrial, Y-chromosome and autosomal DNA sequences. D.J. MELNICK^{1,2,3}, N. ANDAYANI¹, B. J. EVANS³, M.R.J. FORSTNER¹, A.J. TOSI², D. T. THE¹, W. WANG¹, B.M.M. ZAIN², and J.C. MORALES^{1,2}. ¹ Center for Environmental Research and Conservation, ² Dept. of Anthropology and ³ Dept. of Biology, Columbia University, New York.

Molecular markers have been used to reconstruct primate phylogenies for over a quarter of a century. Implicit in their use has been the assumption that the evolutionary historical record is encoded in the genomes of the taxa studied.

We sequenced mitochondrial, Y-chromosome, and autosomal genes from the macaques, Asian leaf monkeys and gibbons to: (1) examine the differences between the phylogenies derived from each gene and determine the causes of these differences; (2) develop robust phylogenies for these primate radiations; and (3) use these phylogenies to identify "areas of genetic endemism" or AGES.

This approach reveals that (1) significant differences between the genome-specific phylogenies developed for the same taxa, (2) phylogenies incorporating all of

the genetically encoded historical information are far more complex than previously suggested from morphological or single genome analyses; and (3) the overlap of phylogenetic breaks among the three primate radiations examined strongly infers the location of major biogeographical events in Southeast Asia. These results underscore the importance of sampling more than one gene, genome, and geographic area from each taxon when reconstructing the phylogeny of a specific primate radiation. This research was supported by NSF grant 9707883.

A rare case of periosteal osteosarcoma of the mandible from the Late Archaic Ward Site (McL-11), McLean County, Kentucky. R. P. MENSFORTH, J. WAY-MOSAKOWSKI, K. E. ZEMAN, Cleveland State University, Cleveland, Ohio 44115

Osteosarcomas are recognized as the most common primary malignant bone tumor which occurs in humans. With a reported incidence of 1/100,000, osteosarcomas exhibit differential age and sex distributions where those at greatest risk are young males ranging in age from 15 to 25 yrs. Male:female sex ratios reported in association with osteosarcomas range from 1.32-1.50. Though similar with respect to sex ratio, osteosarcomas of the jaws (i.e., mandible and/or maxilla) differ from the dominant osteosarcoma pattern in several ways: (1) with regard to bone involvement, osteosarcomas of the jaw are markedly atypical; (2) the frequency of jaw involvement is very low (6% of all osteosarcomas); (3) among those affected, the age at peak incidence for osteosarcomas of the jaw is approximately 10 years higher (33 yrs.) compared to the predominant age group at risk; and (4) osteosarcomas of jaw bones generally remain localized and exhibit a much lower propensity for metastasis as the disease progresses.

The purpose of this study is three-fold. A description and diagnosis of a rare case of periosteal osteosarcoma is presented first. The individual affected (UKMA 12-43) is a Late Archaic adult male from the Ward Site (McL-11), McLean Co., Kentucky. Skeletal age indicators suggest an age at death of 27.7 yrs (\pm 2.8 yrs). The periosteal osteosarcoma affecting the individual is situated at the base of the right lateral ascending ramus, and exhibits the sunburst pattern of new bone characteristic of osteogenic sarcomas.

Second, the study presents a summary of current oncological research indicating that mutations of tumor suppressor genes *RB1* (chromosome 13) and *p53* (chromosome 17) play a pivotal role in the development of osteosarcomas in humans.

Third, with respect to current controversies about accuracy and reliability of paleodemographic age distributions, the study explores the extent to which frequencies of J-Type secondary bone cancers may serve to assess levels of post-reproductive survivorship in prehistoric human groups.

Mitochondrial DNA variation and male affiliation, and cooperation in wild Chimpanzees.

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We sequenced 349 bases of the first hypervariable region of the mitochondrial DNA control region (nts 16026-16375 of the Anderson et al., 1981 human reference sequence) of 23 adult males from an unusually large community at the Ngogo study site in the Kibale National Park, Uganda. We compare genetic variability and relatedness as determined with mtDNA with behavioral observations of male affiliation and cooperation. The behavioral data includes observations of associations, proximity, grooming, alliances, meat sharing, and boundary patrols. The kinship/relatedness data used identically shared haplotypes or Kimura 2-parameter genetic distances. Our results show that matrilineally related adult males do not affiliate with each other closely, and that mtDNA haplotype sharing could not predict affiliation as determined by associations, grooming or proximity. Cooperation was not predicted by mtDNA haplotype sharing either, as observed coalition partners do not share haplotypes.

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Infant and child mortality patterns in Åland, Finland. J.H. MIELKE, Department of Anthropology, University of Kansas, Lawrence, KS 66045.

Both Finnish and Swedish source materials for studying demographic history are of exceptional quality. Providing detailed information both on vital events and on population size and structure since 1749, these statistics form an excellent base for investigating demographic developments in the past. Using these historical and archival resources, the purpose of this paper is to explore infant and child mortality patterns in Åland, Finland, from 1751 to 1875. Up to the second quarter of the nineteenth century, average mortality in the Åland archipelago, as measured by life expectancy at birth, was high when compared to both Sweden and Finland. However, expectation of life at age five (e_5) was often higher in Åland than in Finland. Differences between the general levels of mortality vary, but the pattern of age-specific differences is consistent. Infant mortality in the archipelago was always high when compared to the Finnish national average. However, mortality for children (1-9 years of age) was well below the Finnish average. This pattern resembles the cohort response which Meindl and Swedlund found operating in the Connecticut River Valley of Massachusetts. The explanation may be that those individuals who were able to survive infancy were more resistant to diseases than a similar cohort that did

not experience such high early mortality. Other explanations are possible. For example, the epidemic periodicity and relative isolation of the archipelago may help explain these differences. Another feature that emerges when the mortality patterns of Finland and Åland are compared is the rather high probability of death in Åland for young adults. Tuberculosis, malaria, accidental (drownings) deaths, and levels of immunity may explain this pattern.

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Mission San Juan de Capistrano, then and now: A re-evaluation of the impact of European Contact on Native American health in Texas. E. MILLER, Anthropology, California State University – Los Angeles, CA 90032.

Ten years ago, this author presented as part of her M.A. thesis an evaluation of the impact of European Contact on the health of Native Americans in Texas, using a sample of skeletal remains recovered from Mission San Juan de Capistrano (MSJ), San Antonio, Texas. The results of her initial comparison of MSJ, another Texas mission (San Xavier de Horcasitas), and two prehistoric sites (Blue Bayou and Palm Harbor), led to the conclusion that the impact of missionization in Texas was as deleterious as the impact noted in similar studies elsewhere.

Since that initial study, the Archdiocese of San Antonio has negotiated for the return of the human remains to MSJ for reburial. Faced with this repatriation, the Center for Archaeological Research (CAR) at the University of Texas, San Antonio (UTSA), which curates the remains, has allowed several groups of researchers access to the collections for analysis. Differences in MNI and pathology were noted between their findings and the original findings of this author, and the CAR requested this author return to re-evaluate the sample.

This re-evaluation by the author did show changes in both MNI and the frequency of some of the pathological conditions documented during her M.A. work. Some of these differences are due to the author's continued education within the field of paleopathology, exposure to additional samples, and refinement of diagnostic skills. Others are due to the long curation of the sample, its use in teaching prior to NAGPRA, and the curatorial problems posed by multiple researchers using materials. The bulk of the differences, however, seem focused around changing interpretations within paleopathology.

This paper discusses not only the "new" interpretations on the impact of Contact on health in Texas, but also the importance of long-term curation and re-evaluation of skeletal remains from archaeological sites, and addresses the potential impact of repatriation through use of the case study of Mission San Juan de Capistrano.